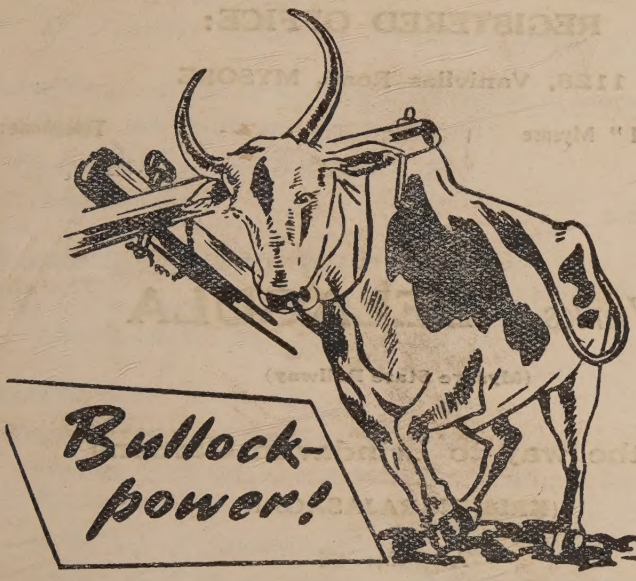
The Mysore Agricultural Journal

(The Organ of the Mysore Agricultural and Experimental Union)

Vol. XXII] 1943–44 [No. 2



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The Mysore Agricultural Journal

(The Organ of the Mysore Agricultural and Experimental Union)

Vol. XXII] OCTOBER—DECEMBER 1943 [No. 2

Loss of Soil Fertility

BY

G. S. KURPAD, B.A.

To overcome the situation resulting from the shortage of foodstuffs, all kinds of methods are being pursued. Every method which shows any promise of adding to our store of food material is eagerly being examined. During the excitement of all the frantic search after methods of increasing our stock of foodstuffs, we are apt to forget what should be done in pursuance of what has been called a " Long Range Policy " for increased food production.

A consideration of this problem leads us towards what Dr. Hopkins calls " Permanent Agriculture ". This is the name given to that kind of farming which leads to big yields, and which at the same time maintains and improves the fertility of the land. Such a system of farming naturally involves all methods for increasing food production and all methods which add to the fertility of the soil. These methods will include firstly, proper tillage of the soil by up-to-date methods, use of the best strains of seed, application of proper manures and fertilizers and the adoption of latest methods of cultivation, and secondly, the adoption of proper rotation of crops, the adoption of all methods which will prevent the loss of fertility from the soil and following such systems of cultivations as will enrich the soil instead of depleting them.

It is desirable to draw up a comprehensive policy involving all the points mentioned above. One or two points which are not usually paid attention to, may be noticed here. The proper tillage of the soil by up-to-date methods, use of the best strains of seed, application of proper manures and fertilizers, and the adoption of the latest methods of cultivation, and the rotation of crops are matters which are fairly well understood by most people and where circumstances permit, all these are given proper consideration.

The prevention of the loss of fertility from soils and the building up of soil fertility are matters to which sufficient attention is usually not paid. It is proposed to consider these in this article.

Fertility is lost from the soils in various ways. Plants that grow in the soil take up varying quantities of fertilizing material and to that extent reduce the

fertility of the soil. A certain amount of fertility is carried away through sub-surface drainage. This loss is more in soils which receive irrigation than in others. Since the excess of sub-soil moisture must be removed by proper drainage for healthy growth of plants, this loss cannot be prevented to a great extent. Another way in which fertility is lost is by surface water. This removes most of the finer particles of the soil every time there is a surface wash due to rain. The loss of these fine particles means the loss of fertility. If this loss is stopped absolutely, as it can be, we shall have gone some way in conserving the fertility of the soil.

It is obvious that the rate of wash depends on the slope of the land. Where the land is level, there is comparatively little wash; where the slope is pronounced, the wash is considerable. The loss due to this kind of wash is really great but somehow, no serious attempt has been so far made to prevent this loss. The only way to do this would be to get rid of the main cause, namely excessive slope of the land. This is called levelling. To get the full effect of this levelling, one has to throw up small bunds at intervals along the slope to prevent the rapid rush of water, when there is a heavy rainfall. The ideal would be reached when all the water that is received as rain is allowed to drain away only through the soil and none of it goes as surface wash.

The loss due to this surface wash may be considered too trivial to worry about. Apart from the fact that in this country where the soils are generally starved for want of fertilizing materials, and that under such conditions even the smallest loss is serious, this surface wash gradually eats into the soil and in course of time this erosion sets up nullahs and gullies which means the loss of hundreds of acres for cultivation. This formation of gullies by erosion can be seen in the Kolar District, Chitaldrug District, Tumkur Dislrict, and Mandya District. So although the annual loss by erosion is small, the accumulated loss is considerable and results in the loss of thousands of acres of valuable land.

The levelling and bunding of lands is not a new thing to Indian Agriculture. The throwing up of sloping land into level terraces and breaking up these terraces into small plots by bunding are common enough sights wherever paddy is grown. This is done because, paddy cannot be grown unless this kind of levelling is done. So that levelling and bunding is more or less an accepted practice where the immediate exigencies of cultivation demand it. It looks almost preposterous that the same practice involving so much labour should be recommended for dry crops. A little careful consideration of all the circumstances will prove to the people concerned that the same process of levelling ought to be extended to all cultivated areas if the loss due to erosion is to be checked.

It may be argued that the cost of such levelling is so great that it cannot be thought of as a general practice. This is not a correct attitude since this question is not considered at all when land is prepared for paddy. If it pays to do so much work for paddy, surely it ought to pay for other crops. Further in the case of other crops, this work can be spread out over a period of two or three years and then the annual cost will be considerably lessened. Also the amount

of levelling and bunding for the other crops will not be so much as in the case of paddy. It is therefore not really a question of cost but a belief that such work is unnecessary that stands in the way of levelling all cultivated areas. If contour bunding is adopted, quite big plots of level land can be laid out and the cost per acre will then be negligible.

Work of this nature requires careful planning and very careful laying out. The assistance of experts is essential and this the Government ought to be able to give to all who want to adopt this method of preserving the fertility of their land.

Some Simple Means of Keeping Food Grains in Storage Free from Insect Infestation and Damage

BY

B. KRISHNAMURTI, B.Sc., F.R.E.S.

Entomologist

The prevailing conditions of shortage and rationing of food grains make it necessary to store grains and other commodities in varying quantities in many centres. Food grains in storage for shorter or longer periods are commonly and easily liable to be infested and seriously damaged by several kinds of insects (and some mites) if they are not stored and handled in a proper manner.

THE PRINCIPAL INSECT ENEMIES OF GRAINS IN STORAGE

The insects concerned belong mainly to the groups of beetles and moths. Beetles form the greater majority of insect populations infesting stored grains, besides being more destructive, since both the adult and the larval stages feed on and damage the grains. In the case of moths it is the larvæ that cut up and bore into the grains while the adults remain harmless.

I. Rice :—
   1. *Corcyra cephalonica* St. (Moth)
   2. *Calandra oryzæ* L. (Weevil)

II. Ragi :—
   1. *Rhizopertha dominica* F.
   2. *Alphitobius* Sp. (Beetle)

III. Paddy :—
   1. *Sitotroga cerealella* Ol. (Moth)

IV. Wheat :—
   1. *Calandra oryzæ* L.
   2. *Rhizopertha dominica* F.
   3. *Trogoderma granaria* (Beetle)
   4. *Sitotroga cerealella* Ol.

V. Jola :—
   1. *Corcyra cephalonica* St.
   2. *Tribolium* Spp. (Beetles)
   3. *Calandra oryzæ* L.

VI. Pulses :—
   1. Bruchid Beetles (*Bruchus chinensis*, etc.)

These insects mentioned against the several food grains are the most common of those that attack them and under favourable conditions they are able to cause very severe damage and loss. They can breed quite uninterruptedly over long periods, if the grains are left improperly stored and uncared for and undisturbed, for any length of time ; all stages of development are usually found in the infested grains and the overlapping generations breeding in them offer a very serious problem to control unless the entire stock of grains are thoroughly fumigated. In the case of food grains meant to be stored for some months or

longer complete prevention of any initial infestation by insects should always be aimed at and this is possible only by adopting correct methods of storage and handling.

Places of Bulk Storage

It is very necessary and highly desirable that the places selected for storing, should be thoroughly well lighted, airy, dry and rain proof. The windows, door ways and ventilators, are preferably to be covered with fine wire-mesh so as to facilitate the maintaining of constant and free circulation of air, even when the storage places are shut up for the night. Dark, warm and humid interiors offer a very suitable and alluring environment for several of the common stored grains' insects to establish themselves and breed rapidly and in large numbers. Where the grains in storage are already infested, the heat and water vapour usually produced by the live insects considerably add to the internal stuffy atmosphere which further favour insect multiplication and help in serious damage to the grains.

Dampness of floor and wall spaces, where unavoidable, can be effectively prevented from affecting the grains by using a thick layer of paddy husk or straw on the floor, and a lining of tar or white-lead coated bamboo or other matting for the walls. A periodical turning over of the husk or straw and turning inside out of the matting should, however, be carried out in order to prevent or check the activities of termites or white-ants which prove a serious menace under such conditions, during and just after the rains.

The importance of maintaining cleanliness in the interior of store houses, cannot be over-emphasised. Grains should not be allowed to lie loose and scattered about and uncared for ; quantities of them that may unavoidably get thrown about, during the course of transferring, measuring or such other operations, should be collected frequently and dumped into certain receptacles with tight fitting lids, specially maintained to receive them and later winnowed and dried in the open before storing or distributing or disposing them otherwise. If these precautions are not taken and continually observed, the insects thereby get very convenient and ready nuclei in loose grains, to start breeding and multiplying and thus form nearby and dangerous sources of infestation of sound grain in store houses.

A great deal of damage and loss of stored grains is often due to the activities also of rats, bandicoots and squirrels which force entry into the places of storage. The holes they cut in gunny bags and other vulnerable materials to get at the grains, also afford ready ingress to the destructive insects. While the rodents can to some extent, be controlled by such means as trapping and poison-baiting, the best method of thoroughly checking the trouble would be to spot out and systematically fumigate and block up their burrows in and around storage premises.

Essential Measures to be Adopted

As these have a close bearing on the nature and age of the food grains to be stored, the latter may be classified as :—

(a) Old grains free of insect infestation meant to be stored for a period inside of 6-8 weeks.

(b) Old grains free of insect infestation meant to be stored for a period of two months or longer duration.

(c) Old grains fairly or badly insect-infested, meant to be stored for shorter or longer periods.

(d) Recently harvested grains meant to be stored for shorter or longer periods.

(e) Very badly infested grains.

In the case of the first (*a*) category of grains meant for quick distribution and use, no special method of storage may be necessary. The most prevalent method of storing in gunny bags would answer the purpose of storage well, provided the precautions noted hereunder, are taken and constantly observed. The bags should not be in direct contact with either the floor or wall spaces; they must be stacked preferably on conveniently raised scaffolding or on husk or straw covered flooring unless the latter is perfectly hard, smooth and dry but, in any case, well away from the walls and the ceiling; the bags are, besides, far better stacked alternately, lengthwise and crosswise leaving about a foot of space in between the rows, instead of all of them being arranged in the same manner and close together as is usually done in the godowns of grain merchants. This renders better and requisite lighting and aeration in between the rows, possible, besides also maintaining the desirable amount of pressure on individual bags in each row.

In addition a regular means of preventing and controlling the establishment and the multiplication of the several varieties of insects that may possibly gain entry from the neighbourhood into the storage centres, should be adopted and systematically practised. Such means consists of spraying the interior (floor, walls, doors, and even the ceiling and all cracks and crevices as well as the bags themselves, especially where they do not get the full weight of the others on them) with a petrol or kerosene extract of pyrethrum by means of a fine-nozzled syringe pump, so as to produce a fine mist of the extract all over the interior at least once a day in the evening or at night before closing. All the dark and warm nooks and corners and such other spaces should be very thoroughly covered with the spray. This operation effectively prevents and removes most of the insects affecting stored grains, while leaving the bags and their contents quite unaffected. The spray material is prepared in the following manner :—

$\frac{3}{4}$ pound of pyrethrum powder is soaked in 1 gallon of petrol or kerosene for 24 hours; later, the mixture is thoroughly filtered; the used up powder may be soaked again in a small quantity of the liquid and well pressed and squeezed so as to obtain the active principle of pyrethrum to the utmost limit possible. To the filtrate another gallon of petrol or kerosene is finally added and well stirred. In order to mask the smell of petrol or kerosene, lemon grass oil or any other essential oil is also added on to this filtrate at the rate of one to two fluid ounces per gallon of the mixture and stirred.

In the case of the third and fourth categories (*c* and *d*) of grains in storage one very important and essential preliminary and precautionary measure to be

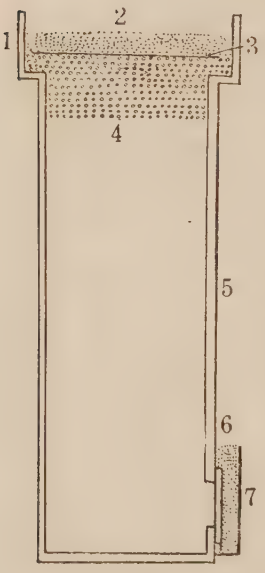
taken, is to thoroughly sun-dry them for a few hours, spread out in thin layers and kept frequently turned over and the insects crawling out of the grains promptly and entirely swept and collected together and destroyed; sun-drying is especially necessary in the case of grains recently harvested, in order generally to reduce their moisture content, below the level of the optimum normally required for insect infestation. The grains are usually sun-dried to some extent during and subsequent to the process of threshing after the harvest but are rarely sufficiently dried before they are removed from the threshing grounds. It is therefore extremely essential to insist on the grains being thoroughly sun-dried on the threshing grounds prior to their removal; or alternately to get certain centrally located drying grounds prepared for adequately drying the grains before stocking them in storage centres. Where the 2nd category (*b*) *i.e.*, old stocks of grains remaining uninfested by insects and meant to be stored long, is concerned, the grains may not be subjected to sun-drying unless they are suspected to have previously been badly affected by exposure to moisture and dampness.

Paddy stocked loose or in bags in rice mills is liable to serious damage by the moth (*Sitotroga cerealella*) if it is not milled quickly. Wherever it is likely to remain as such for a short period of about a month or two, it should be subjected to frequent spraying; in the case of large heaps in the mill godowns, spraying the loosely packed outer fringes to a width of two feet should be enough, since the pest gets a start there. The dark and warm parts of the interior of the mills where the small moths are likely to rest should also be regularly sprayed. If the paddy is to remain unmilled for longer periods, a special method of storing described below should be adopted. The rice should not be allowed to collect in the mills in heaps but filled into bags as it is milled and the bags tightly stitched immediately and removed either to an entirely segregated portion of the mills or transported away from the mills to various centres of storage. If the rice is left in heaps or in open bags or other receptacles in the mills uncared for, for any length of time, it is liable to be seriously infested and damaged by the rice moth (*Corcyra cephalonica*) and the rice weevil (*Calandra oryzæ*); paddy husk and rice bran and other materials left over in the process of milling should also be removed and segregated and prevented from being infested by the moth. As rice mills form very convenient spots for the multiplication and spread of the insects mentioned above, the mill-owners must be particularly vigilant and take every necessary precaution. All these hold good when wheat is stocked for milling, as it is equally susceptible to attacks of weevils and the moth (wheat grain-weevil, wheat-flour and Soji moth, *Corcyra cephalonica*).

Grains of the second, third and fourth (*b*, *c* and *d*) categories should be finally stored in special receptacles of cement concrete or zinc, if they are to remain free from initial or further insect infestation. Split bamboo can also be used for making the receptacles but the external surface of the bamboo bins should be evenly and completely plastered over thoroughly a mixture of red earth and cowdung and mucilage. A final coating or two of thick white-wash should be given and renewed whenever necessary; particular care should be taken to see that the outer plastering does not split or peel off and if and when it happens, the spot should at once be attended to and replastered and bins made

insect proof. This kind of external covering for the bamboo bins, has certain inherent defects that cannot be entirely removed. A much better and more lasting substitute for the purpose of plastering the bamboo bins, is paper pulp into which sufficient mucilage of some kind is incorporated. The mixture may be further improved and made insect proof by impregnation with coal tar emulsion.

The bins may have cylindrical bodies of any required convenient size with an open top. At the open top, to a height 3-4 inches the bins should be made wider to an extent of 4 inches, thus forming a wider neck. The bins should have four openings at equal distances three inches above the bottom, each opening being also provided with a tight fitting and side-sliding door. The wide mouth of the bin is left uncovered by any outer lid but in its place a circular sheet of thin metal or wooden plank two inches less than the internal diameter of the neck, should be used to cover the centre of the internal portion of the mouth, at the point where the bin widens out into the neck. The metal sheet or wooden plank actually rests on the top surface of the grain in the bin when full. Top-most of all, is spread sufficient fine sand to form a two-inch thick layer, so as to cover up evenly, not only the metal sheet, but primarily, also the space between the rim of the sheet and the internal wall of the neck of the bin occupied by the grains but uncovered by the metal sheet. As a further measure of protection, fine powder of pyrethrum or mundulea, may be spread over the sand in a thin layer. The sheet of metal and the sand should be adjusted soon after the bins are filled with the grains through the open top. The four openings with sliding lids should, of course, be kept closed during the process of filling the bins and should continue to be kept closed till supplies of grains are needed, when the lids are moved to a side and the grains allowed to pour out. The openings are to be closed immediately after the necessary supplies are drawn off. When the bins become completely drained out, the sand and the metal sheet at the top should be removed for the bins to be filled in again ; the sheet and the sand being later restored properly to their former position, after filling is over.



Storage Bin

1. Neck.
2. & 6. Sand.
3. Wooden plank or metal sheet.
4. Grain.
5. Centre of the bin.
7. Side-sliding door.

No infestation of sound grains or any further infestation of partially and previously infested grains, inside the bins, can occur when storage is done in this manner. The infesting insects already in the grains, carried over into the storage centres, from the threshing grounds or other places also get out of the grains after a while, when they attain their adult stage. The adult insects automatically crawl to the surface of the sand but find themselves unable to penetrate again. They are to be collected promptly when they appear and destroyed ; in the presence of pyrethrum or mundulea powder, they naturally die a short time after their contact with the powder.

It is very desirable to make it a general rule not to collect and stock very badly insect-infested food grains (category *e*) anywhere and at any time. Any stock of badly infested food grains is a great liability besides being a constant and fertile source of trouble for stocks of sound grains ; its intrinsic value as food material is also very little being considerably tunnelled up and damaged and further defiled by the insect populations. If, however, any stocks of undesirable grains and other food commodities are to be maintained, they should be immediately segregated and subjected to fumigation for a period of 48 hours, with pure petrol (unleaded) in perfectly airtight chambers or godowns, the dose of the fumigant to be used being 1 pint for every 25 cubic feet of space. Petrol having, lately, been found to answer the purpose of killing the larger proportion of insect population in stored grains, may be used in place of carbon-bi-sulphide or Hydrocyanic Acid Gas, which are dangerous poisons besides being unsafe from the consumer's point of view. By thoroughly airing the grains for 24-48 hours after fumigation, the grains become rid of the odour of petrol, while remaining sound from the view-point of consumption as well as germination (provided the germ of the grain is not already damaged by the insect).

Fumigation does not however render food grains immune from subsequent infection ; they should therefore be later stored properly if they are to continue to remain free from insects for long periods.

Summary

1. The principal insects affecting different kinds of grains in storage fall under the groups of beetles and moths.

2. The places of storage should be airy, well lighted and dry and kept scrupulously clean. The trouble by rodents should be tackled by systematic fumigation of burrows in the immediate neighbourhood.

3. The dark and warm portions of the interior of storage places should be systematically sprayed with an extract of pyrethrum to remove lurking insects of different kinds.

4. Bags with grains should be so arranged as to leave ample space in between them and the rows so as to be well away from contact with walls or ceiling.

5. The grains should be thoroughly sun-dried before storing either in bags or bins or other special receptacles ; a layer of sand should always be maintained at the top of the bins and required quantities of grains drawn out from the trap doors below.

6. Special care should be taken by mill owners in mills and godowns to prevent and minimise insect multiplication and damage to grains.

Minerals in Animal Nutrition

BY
G. GOPINATH, B.A., C.D.D., N.D.D. (SCOT.)

Within the brief period of little more than a quarter of a century we have noticed many of the most useful medical and nutritional discoveries, among which the elimination of diseases by the use of Vitamins and Minerals has taken the foremost place. Some diseases popularly termed as Avitaminosis and others termed as "mal-nutritional defects" have engaged the best brains of the world and thanks to them, we are able to solve the problems of many suffering millions. No less brilliant and far-reaching are the discoveries made during the same period and in the same field, with regard to animal nutrition. But, since cattle-breeding and dairying is still in its infancy in our country and since most of the farmers engaged in this field are mostly illiterate and ignorant of scientific facts, we have not advanced so much as we should have by now by taking advantage of the discoveries. Anyhow, the national awakening in Animal Husbandry has contributed towards the improvement of the wealth and the quality of our cattle and many prominent enterprising people are coming forward to whom the scientific aspect of nutrition can be pointed out with advantage. Of the many aspects one of great importance is that of minerals, which is attempted to be described here in a simple language.

"A cow which could be compared to a steam engine at work, needs suitable fuel for its exertion and its working parts must be repaired from time to time with suitable materials. The fuel for the engine, as a rule, is coal or oil, but it needs other materials also for its renovation." In much the same way the animal needs for its work some fuel which comprises two kinds of substances ; carbohydrates, such as sugar, starch, fibre, and other similar substances ; and fats and oils. These carbohydrates and fats, however, do not count for the entire nutrition of the feeding stuff. They are fuel suppliers only. For repair and for other functions they require a different kind of materials, called proteins, albuminoids or flesh formers. Besides these two materials, we have some others which are also essential for the normal functioning of an animal. These include what are known as minerals (like calcium, potassium, phosphorus, iron, etc.) and also some vital substances called vitamins. The nutrition value of any food depends on the presence and proportion of these various substances which it contains. A food with all these substances in useful proportions to perform a certain function is termed scientifically "a Balanced Ration". This term is not universal in its application as one food. The balance of a ration connotes only the purpose it serves and not otherwise. For example, the balance of a ration for a young animal is different (in proportion) from that of a mature animal (though it may contain the essential substances). Lack of any one of these or a bad proportion, for a definite task, is unbalanced and cannot be of much utility.

The common belief is that if any kind of livestock received a ration balanced in proteins, carbohydrates and fats, these will result in good health and profitable acquisition. But, if viewed scientifically, that is not true in the case

of Animal Nutrition. Many dairymen and cattle-breeders have found it very difficult to improve the quality of their herd, notwithstanding that they were given a ration with a proper albuminoid ratio, and they are at a loss to know the real cause for the deterioration of quality and health among many of the herds of our farmers. To study the causes of such failures (in spite of the good feed given) and to prevent their recurrence must be our effort. If we study the causes, it will not be long before we come to know the importance of minerals in animal nutrition.

The animal body, as we all know, is made up of various tissues, bones, flesh and blood. If we go further these again are made up of innumerable single bodies called cells. These cells, the rudiments of development of organic tissue, contain in them a fluid called 'Protoplasm' which is the life-giving fluid. When chemically analysed these are found to contain many minerals in them, along with others called 'genes', which are by the way character transmitting agents. When minerals are found in these small rudiments of life, it is but logical to assume that the various parts of the body also contain these elements in various proportions, since they are but developed cells. We thus clearly see that the formation of a tissue is just but the development of a typical cell or group of cells. For their development they need energy as well as other substances. When a cell is in the womb (being developed) it naturally gets the required substances from the blood of the mother-cow, which need have a good store of them. Otherwise, the development of the fœtus will be affected. Again when the calf is born and weaned off, it has to depend on its own food for its further development and naturally the food has to possess all the various substances required therefor. Is it not then clear that unless and until a good balance of the several minerals is available in the food for assimilation, the development of the cell, and ultimately the whole structural development of the animal will fall considerably ? Again taking the mother animal, unless it has some amount of extra energy and substances in store, besides its own need, how can we expect the fœtus to develop,—the fœtus which develoes only with the help of the blood of the mother cow ? There are only two alternatives, either the development of the fœtus will suffer or the mother animal will have to part with her own need whereby she becomes weak and emaciated and ceases to be productive. Either of these we would not like to have since it is contrary to the very fundamental principles of Animal Husbandry.

It might be asked how the animals in the woods live and reproduce and thrive whare no supplementary ration and minerals are given ? There the cattle get their quota of carbohydrates, proteins and minerals from the grass and plants they graze upon and from the water they drink for a limited normal growth. But when man uses cattle to give him milk and flesh and work, it is needless to say that these expecting maximum effort from them attention has to be given to their feeding; and consequenlty the study of nutrition and its utilisation is of prime importance in the field of Animal Husbandry.

The subject of minerals is specially important as many of us seem to neglect this aspect.

A good 'balanced ration' scientifically prepared always takes care of its mineral requirements since the various ingredients do contain many elements in small proportions. But it is not always possible to prepare a ration so accurate in all its aspects on the practical side. Again the various substances that go to make a consolidated ration may or may not possess the essential elements that are most needed by the animal. For instance, continued cultivation of a field deprives it of its manurial wealth if proper care is not taken to replenish the loss; and naturally the fodder produced on such will only be nominal and may not possess any vitality or utility save that it serves only as a bulk. Again the common method of feeding straw (both paddy and ragi) viewed scientifically only seems to quench the appetite, inasmuch as its mineral worth has all been taken up and absorbed by the grains produced. So these forage crops cut after the growth of the grains, not only lack in nutritive substances but also minerals. Since such feed alone forms the bulk of our rations, the inclusion of minerals are of great necessity. Usually where leguminous green fodder is given as supplementary ration, the demand for minerals will be far less, as these plants do contain a good proportion of certain minerals in them. But, since green grass and leguminous fodder do not come usually well up to the mark in our common rations it is better to include a mineral supplement in the concentrates given.

It has been fonnd by experiment that growing animals and milch cattle need a large amount of minerals especially phosphorus and others rich in lime. A cow of average weight requires for its maintenance $1\frac{1}{2}$ oz. of lime (CaO) and about 4/5 oz. of phosphoric acid H_3PO_4 daily, and for production of 10 lbs. of milk, another $\frac{1}{2}$ to $\frac{3}{4}$ oz. of lime and nearly 1 oz. of phosphoric acid. It is also found that carnivorous animals are usually deficient in calcium and cattle in phosphorus. But growing animals, especially weaned calves, require 1/3 more of calcium and the normal phosphorus of an adult animal for the development of bones, etc. It has been found by American scientists that a 300 lb. calf requires 15 grains of calcium and 12 grains of phosphorus and a 1000 lb. cow requires 9 grains of calcium and 12 grains of phosphorus, for their net requirements. Such an intake insures a normal calcium and phosphorus level, which is approximately 10 to 12 milligrams of calcium and 4, 5 to 6 milligrammes of phosphorus per 100 c.c. of blood. Usually in heavy rainy regions and where heavy cropping has been continued for a long time and in places of soil erosion we find cattle suffering from lack of vital minerals especially phosphorus. "Aphosphorosis" or phosphorus deficiency is usually denoted by stiffnesss of limbs, depraved appetite, sullenness and bone chewing. Deficiency of calcium is indicated by poor growth of structure, arched limbs, poor production, bad teeth, etc.

Breeding efficiency depends on the adequate intake of phosphorus along with calcium and other minerals, and it is not wise to overlook this fact. Usually phosphorus deficiency is the result of low protein intake and this in turn sets the stage for multiple deficiencies. If this is looked after, half the trouble will automatically be solved. Again it is found by experience that phosphorus deficient breeding is susceptible to genital infections and diseases. In South Africa some experiments done regarding the feeding of bonemeal (which is

32 parts of calcium and 14 parts phosphorus) have proved far beyond doubt the utility of minerals in a ration. In one of the stations it was found that the calf impregnation increased by 78% and all the animals showed an improvement in milk yield and non-susceptibility to diseases to a great extent. Common salt (sodium chloride) is another ingredient which has to be supplied, as the concentrated foods given are usually deficient in this ingredient. The uses of this mineral are manifold. It improves the general condition of the animal apart from its being a good appetiser. It enhances secretions and digestion and absorption besides making the dairy cow take enough water for her productions.

All these facts go to prove the importance of minerals in nutrition. As such, an inclusion of mineral supplement in a ration is undoubtedly of great help in good Animal Breeding.

The common method of using rock salt which has been in vogue for a long time, though to a certain extent does benefit the animals, is not at all a shrewd method for the following reasons:—(i) It only supplies salt but it lacks the most important elements. (ii) There is also the risk of fluorine poisoning especially in the calves if pure stuff is not used. (This usually occurs in calves and can be spotted out by the disintegration of the teeth.) So the safest method is to make a composite mineral mixture which could be given at a certain percentage of the total concentrates according to the need. For this a general utility mineral mixture has been suggested which has proved its worth. It is as follows :—

Common salt	.. ..	.. 2 parts by weight
Chalk (well ground)	..	.. 1 „
Bone flour (sterilised feeding)		.. 1 „

This should be fed at 3% of the concentrate feed and no extra salt is necessary. (3 lb. mixed with 100 lb. of concentrate mixture.)

A more complicated mixture with extra ingredients can be used with good results, especially with good milkers and stud bulls.

Bone meal flour (sterilised feeding)		..	50 lb.
Chalk (well ground)	..	..	23 „
Common salt	.. ..	..	20 „
Sulphur	.. ..	..	5 „
Oxide of iron	.. ..	..	2 „

An addition of 4 oz. of potassium iodide is also advised by certain authorities, as it is supposed to help the general condition, reducing the losses due to failure to conceive. This mixture should be administered at 3% of the concentrates. In case such methods are not practicable, it is advised to include 1 oz. of salt and 1 oz. bone meal every day to the ration of all animals, irrespective of their age and work. If the need for minerals is not appreciated especially with regard to growing animals and milch cattle, this omission will tell upon the bones and other tissues whereby the animal becomes weaker and weaker at every lactation and the milk production drops and the productive capacity lessens. A good mineral supplement together with green fodder (at least about 15 to 20 lb. daily to give the necessary vitamins) forms the *Key-Note to the Improvement of our Cattle.*

SELECTIONS

Tomato Cultivation of the College Farm

(Imperial College of Tropical Agriculture)

Tomatoes are a dry season crop on the College Farm. The heavy rainfall of the wet season is inimical both directly and indirectly to their productivity. The direct effect has not been investigated, but indirectly heavy rainfall favours a great increase in gall midge infestation. The larvæ of this midge cause flower shed.

1. Nursery Management

(a) Varieties.—In 1934 a varietal experiment failed to pass the Z test; there may or may not have been differences in yield between the varieties concerned, namely Marglobe, Bonny Best and Red Rock. Marglobe fruits were, however, considered preferable for export, they were easier to pack, being more uniform in size and shape than fruits of the other two varieties. They also gave better slices when cut for they were less creased at the stem end.

(b) The Nursery.—Usually seed obtained from the United States is broadcast on beds about the beginning of November. In 1941 the rate of sowing was one ounce of seed (9,000 seeds) produced an average of 4,140 seedlings two days after germination and 965 transplants five weeks later. After sprinkling soil thinly over the seed the surfaces of the beds are slightly consolidated by beating them gently with a piece of board. The beds are then watered and covered with cocoanut leaves. Seedlings appear about three days later, whereupon the shade leaves are removed to structures above the beds, until the seedlings are strong enough to withstand heavy rain. The beds are watered in the morning and evening but care is taken not to overwater them for fear of increasing "damping off". When one or two weeks old, seedlings are pricked out four or five inches apart in beds manured with compost and artificials, to prevent overcrowding and to reduce losses from "damping off". It is advisable to shade seedlings for two or three days after pricking out. About one or two weeks after this operation the beds are worked with a trowel fork to break their surface "pan". It has been customary in the past to water sparingly during the last week before transplanting to "harden" the seedlings. In 1941 this was proved unnecessary, for it was found impossible to produce "tender" seedlings, even by shading, manuring and waterfng copiously.

2. Field Cultivation

(a) Transplating.—In early December the field in which the crop is to be grown is given ten tons of compost per acre; it is then ploughed and ridged. The ridges are finished with hand hoes. Plants are grown on ridges as a precaution against heavy rainfall in late December and in order to make furrow irrigation possible, later in the season. Plants are transplanted in the late afternoon and watered afterwards.

(b) Planting Distances of Staked Ptants.—When tomato plants are grown from seed of the same origin in the tropics and in North America, they yield much less in the tropics. A consideration which governs the spacing of tomatoes is that the less productive the type, the closer should be the spacing. Experiments in spacing on the College Farm have proved the usual American planting distance of two by three feet for staked plants to be too great for our conditions. In 1934 staked plants, pruned to a single stem, grown on ridges three feet apart, gave significantly greater yields per unit area when set 1½ feet apart on the

ridges than when two or three feet apart, while plants two feet apart gave significantly greater yields than those at three feet. In 1942 both staked and unstaked plants, on ridges three feet apart, gave significantly heavier yields when at one foot than when 1½ or two feet apart, while those at 1½ feet yielded more than those at two feet. In North America rows of tomato plants must be set at distances which will allow mechanical cultivation to be carried out. It is because of this that row distances are so uniform over that continent. On the Farm, however, distances need be only enough to allow for ridging and the use of the hand hoe between the rows.

(c) Staking and Planting Distances of Unstaked Plants.—Bamboo stakes six to eight feet long are placed firmly in position four to six inches away from plants soon after transplanting. Plants are tied to these stakes with string, fibre or strips of banana midrib.

In 1933 and 1934 staked and pruned plants were matched against unstaked and unpruned plants in two experiments, both of which failed to pass the Z test, thus there may or may not have been differences in yield between the treatments. In 1942, staked and pruned plants yielded a significantly greater weight of fruit than unstaked and unpruned plants ; three spacings ; one by three feet, 1½ by three feet and two by three feet, were equally represented in both treatments. In this experiment the plants were irrigated four times. Rows of unstaked plants proved to be too closely spaced for them to escape damage from irrigators and irrigation water. This damage resulted in reduction in yields and premature death of some plants. On 28th March there was a stgnificantly greater number of blank plant sites in the unstaked plots. This factor contributed to the low yield of the unstaked plants.

In the 1942 spacing experiment the treatments included unstaked plants as well as staked and pruned plants. In America unstaked plants always require more room than staked plants and pruned plants ; it was therefore expected that the wider the spacing the greater would be the yield of the unstaked plants. It is suggested that this was not so, partly because irrigation damage removed only an excess of the plant population from the closely spaced plots, but caused a deficit in the widely spaced ones.

(d) Pruning, Tying and Topping.—Early in January all side branches of staked plants are pruned and the plants are, at the same time, tied to the stakes. Care is taken to tie inflorescences away from the stakes to avoid the bruising of the fruit against them. These operations are carried out once a week from then on. When plants begin growing out of reach at the age of four months, they are topped, and a side branch is allowed to develop in place of the main stem growing point.

(e) Mulching.—In 1942 a mulch of 8·8 tons per acre of dried cane trash was included in the experimental lay-out. It was applied at the end of January after the field had been irrigated twice. The mulch variance did not pass the F test, thus mulching may or may not have affected the yield of plants.

(f) Miscellaneous Cultural Practices and Harvesting.—The stands of experimental plants have received varying amounts of irrigation depending on the severity of the dry season. Thus in 1934 they received one irrigation, in 1935 five irrigations, while in 1942 four irrigations, amounting to 13·4 inches of water, were required.

Weeds are not plentiful during the dry season, so only one or two weedings are necessary. Should transplanting occur when the ground is soggy, additional hoeings or inter-cultivations are essential to break the concreted conditions of the dried ridges.

In all experiments fruits were harvested in the mature green stage and their pedicels clipped off to prevent bruising during storage. Fruits were then

divided into damaged and undamaged lots. The undamaged or exportable fruits were classified into three grades : Fruits of (i) diameter greater than $2\frac{3}{4}$ ins.; (ii) diameter between $2\frac{3}{4}$ and $2\frac{1}{2}$ ins.; (iii) diameter between $2\frac{1}{2}$ and $1\frac{3}{4}$ ins. Those with diameter less than $1\frac{3}{4}$, together with damaged fruit, were classified as unexportable fruit.

3. Artificial Manuring

Three manurial experiments, in 1933, 1934 and 1935, failed to yield informations concerning the manurial requirements of the crop. The variances for treatments did not pass the F. test. In 1942, the crop was manured with artificials, in the proportions of three parts of nitrogen to four parts of phosphorus pentoxide to three parts of potassium oxide, at the rate of 1,260 lb. per acre. This was placed in holes six inches away from the plants in three monthly applications; the first soon after transplanting. Each plant in the experiment received an average of two ounces of artificials.

4. Yields and Profits

Year	Total yield tons per acre	Yield of exportable fruit T.P.A.	Tons of fruits actually sold	Received from sale $ per acre	Cost per acre $	Profit
1933 ..	3·8	1·4	?	400	200	200
1934 ..	4·3	?	3·9	436	203	233
1934 ..	2·8	2·3	2·4	209	194	15
1935 ..	?	?	4	315	233	82
1942 ..	3·5	1·4	2·6	589	503	86

5. Root Studies

In 1942 root studies, in which Weaver's trench method was used, showed that the roots of both staked and unstaked plants, five months old, extended to a depth of five feet. Unstaked plants had a greater root development than staked and pruned plants.

6. Pests and Diseases

(a) Pests.—The important pests of the nursery are mole crickets and flea beetles. In 1934 a 1 to 32 mixture of Paris green and flour, used as a dust, controlled flea beetles. In the field the gall midge (*Contarinia lycopersici*) oviposits in unopened buds, were inoculated with one to three gall midge larvæ, in an attempt to discover whether these larvæ were responsible for a well-defined type of damage, known to occur early in the fruit's development. Mature fruit suffering from this damage have characteristic deep wounds, which sometimes nearly divide the fruit in two. 73 per cent. of the inoculated buds withered and fell; the remaining 27 per cent. developed into undamaged fruit; it was considered that the larvæ in these jumped out immediately after inoculation. In no case did an inoculated flower develop into a damaged fruit. Gall midge larvæ are not therefore responsible for "early" damage. Fruit borers (*Prodenia* and *Heliothis* species and another unidentified small, transparent web-spinning caterpillar), are usually controlled by hand-picking; so also is the hornworm (*Protoparce* species), which defoliates plants. Other field pests include *Cerambycid* beetles (*Alcidion* species),—which kill plants by tunnelling up the stems; Coreid fruit suckers, flea beetles and mole crickets.

(b) Briant and Baker have written articles on tomato diseases in Trinidad. In 1934 and in 1942, sclerotial wilt or "Southern blight" *(Sclerotia Rolfsii)*,

was the commonest wilt in the field. Ageing is accelerated by eel worm (*Heterodera radicicola*), which is extremely common, and leaf spots (*Alternaria* and *Phoma* species).

In 1942, it was shown that the curve of growth cracking, expressed as a percentage of the weight of each harvest, was a reflection of the curve of water received by the field and the yield curve. The latter approximates to the curve of the speed of growth of mature plants. In other words predisposing conditions, for growth cracking are: (*a*) Rapid growth after slow, (*b*) continuous rapid growth.

In 1942, results suggested that the fruit of staked and pruned plants suffered more from physiological diseases (growth cracking and blossom end rot), than did the fruit of unstaked plants. It was thought to be the result of an unbalanced water relationship, which was due to a greater exposure of staked plants to drying conditions; rather than to the foliage of unstaked plants conserving water by mulching the soil under these plants. The fruit of unstaked plants suffered more from miscellaneous types of damage (mainly scarring) disease (in the field) and sun scald. In 1934, a fruit disease termed " centre rot " was reported; no external symptoms are exhibited by fruit suffering from this disease.

B. F. Topper, B.A. (Cantab.)

—" *Tropical Agriculture*," Vol. XIX, No. 9, Sept. 1942.

Lucerne as a Food

Powdered lucerne processed to retain almost its complete nutritive value has been manufactured in trial lots, and dietitians say that it should be as beneficial to human beings when fresh vegetables are scarce as it is to cattle. Scarcely noticeable to the human taste, it can be added to stews and soups and used in the preparation of all green canned vegetables. Vitamins of lucerne have been processed into chocolate which will be supplied to the fighting forces. It is said to be a valuable food, rich in energy-producing sugars, proteins and anti-scorbutic vitamins. The food value of a table-spoonful of dehydrated lucerne exceeds that of a large cabbage. A large plant for production of the powder has been ordered, and the defence authorities hope to be able to supply all service requirements and provide a surplus for sale to the public. A plant capable of handling half a ton of lucerne daily and powdering about 6 lb. of leafmeal an hour is already at work.

—*Trade & Engineering*, December 1942.

(*Indian Farming*, Vol. IV, No. 3, March 1943.)

Test for Over-polished Rice

In a number of tests carried out to find a method by which undermilled rice can be distinguished from over-polished rice, it was found that iodine solution of 0·05 per cent. strength turns the polished rice grain to blue-black in 60 seconds, while the same solution gives rise to streaks of blue-black colour on rice that is under-polished.

It was seen that rice passed twice through the huller turns blue-black while rice passed once shows only streaks of blue-black, indicating thereby that the bran layer has not been completely removed. It has been found that a single milling is enough to produce good cooking quality in rice. The above test

will be of use to distinguish the undermilled from the highly polished rice, when the State regulates the degree of polishing of rice, so that 4 to 5 per cent. more of rice stocks could be obtained by undermilling.

—*What's Doing In All India, Madras.*

(*Indian Farming*, Vol. IV, No. 3, March 1943.)

Agriculture in Mysore

Concentrated work was carried on in the laying out of demonstration plots, subvention farms and 'A' seed plots in selected hoblis in connection with the Rural Reconstruction drive. Above 4,460 demonstration plots, 2,343 'A' seed plots and 208 subvention farms were laid out in the various taluks of the State.

A second grade agricultural colony under the Marconahalli Reservoir was sanctioned for the benefit of educated young men. Twelve colonists have already taken charge of their blocks and begun the work of cultivation. The colonies in the Irwin Canal area worked satisfactorily.

During the summer of 1943, a scheme for growing irrigated ragi in the channel areas was started and an area of about 6,800 acres was grown with ragi. Experiments in the Chemical Section have indicated that nearly 60 per cent. of the manures generally used for crops may well be in the shape of locally available material like compost, oil-cakes, bone-meal and wood ashes and that this will reduce the cost by 40 to 50 per cent. in the case of sugarcane and 75 per cent. in the case of paddy.

Agricultural implements of the value of Rs. 2,42,489 were distributed to the raiyats.

Work was continued under the Dodhatti Cotton Scheme in co-ordination with the Indian Central Cotton Committee. As a result of breeding work carried on in sugarcane, H.M. 661, H.M. 647, H.M. 645 and I C. 136 have been selected for popularisation in the Irwin Canal and Vani Vilas Sagar areas.

A scheme for the development of fisheries in the tanks of Kolar District is under consideration.

There are now 84 Veterinary Dispensaries in the State. The Serum Institute supplied 629,200 doses outside the State. Poultry and sheep farms and the Sheep Breeders' Association continued their good work. The work under the Liver Fluke scheme is reported to have greatly reduced the mortality of cattle in the Irwin Canal area. Research work was continued on Jhone's disease, poultry diseases, sheep breeding and partly by the Imperial Council of Agricultural Research. A Dairy Cattle Society has been started at Bangalore.

From the Dewan's Address to the
Representative Assembly.

—'*Mysore Information Bulletin*', Sept.–Oct. 1943,
Vol. VI, Nos. 9 and 10.

Home-made Dehydrator

It has been rightly said that an "army marches on its stomach"; and to feed the present war's colossal numbers would have been a staggering problem but for the discovery of dehydrated foods.

Dehydration is the removal of water from a properly prepared food under controlled conditions of artificial heat and air in motion. Such a dehydrated product can not only be stored for a very long time but can be packed in considerably less space.

A dehydrator may be made at home from the simple types of materials which can be procured locally, or it can be made of elaborate types of materials. In either case its usefulness will be the same. Sheet metal would be the most durable, but where this is not available, plywood is the next best. The 3/8, 3-ply plywood which can be purchased anywhere will serve admirably.

For a simple type, you will only need a box with a hinged door that fits tightly and is approximately 15-in. square and about 30-in. high. Such a box, made of plywood, requires 1-in. square strips in each of the four corners to hold the dehydrator firmly together. It also needs runners at intervals of 2-in. apart which will hold the trays on which the prepared food is placed.

The base of the dehydrator should have a metal plate to use as a heat-spreader, instead of a wooden bottom. The closer the contact between the source of heat and the base the better. Since, in most cases, the dehydrator will be made of wood, it is advisable to have legs which will definitely hold the dehydrating equipment away from or above the source of heat. Legs of wood or metal three or four inches in height will serve to eliminate the fire hazard.

Creating a Draft

The heat-spreader should always be placed on the bottom of the dehydrator. Painting the entire base with a heavy solution of water-glass will serve to fireproof it. A flue should be located on the top to encourage a rapid flow of air through the dehydrating product. If a small electric fan running it at a low speed, is fixed at the bottom of the dehydrator, it will greatly facilitate the drying operation and improve the quality of the finished product.

Where a fan is not available, leave a rectangular opening, 6-in. by 15-in. in the centre of the top of the dehydrator. Place a bottomless box over this opening and you will have a flue which will aid in creating a draft. At the bottom of the side-wall of the dehydrator, close to your heat-diffuser, bore six holes on either side, using one-inch bit. This will encourage normal air flow which will give satisfactory results.

Trays made of $\frac{3}{4}$-in. stock, the ends notched together and nailed will serve successfully. It is preferable that the bottom of the tray should be of screen wire or cloth netting. Cheese-cloth should be laid over the tray when it is to be covered with food. Experiments have shown that dehydration is best carried on at a temperature of 145-deg. Fahrenheit.

Selection

It is necessary that preparation of the vegetables for dehydration should be carefully made. The vegetables should be harvested and prepared as soon as possible since storage of any product rapidly causes it to lose its flavour and quality. They should be picked at the optimum date of maturity and processed immediately. First, they should be washed, particular care being taken to see that sand and grit are removed from all leafy ones.

Dehydration is achieved primarily by the surface evaporation of the moisture from the product. The greater the surface of the product that is exposed to the current of air, the more rapid will be the drying process. Root vegetable should be sliced, diced or shredded to facilitate drying. After being sliced, they should be blanched, that is pre-cooked in hot water, to destroy any enzyme activity which tends to bring about a change in the composition and appearance of the product.

Loading the trays is the next important step. The pieces should have as little contact with each other as possible. With room for air circulation between each of the slices or leaves results will be satisfactory. With the products to be dehydrated neatly trayed, and with a dehydrator previously warmed up to a point of 145-deg. F., the trays can be placed and the operation started. The temperature will first come down and then work its way up slowly until it is back to 140. It is here that the dehydration process finishes.

Rehydration

Under no conditions should the heat adjustment be changed after it has originally been determined in operating the dehydrator. After the product has been dehydrated it is important to handle it correctly. Dehydrated foods will rapidly absorb moisture and hence they should be put into moisture-proof or air-tight containers. Glass or stone-jars make excellent containers, as they have usually tight-fitting covers.

Lastly, it may be added that rehydration of any dehydrated product cannot be over-emphasised. This process consists in taking the amount you think you are going to use and soaking it in water at room temperature until it is completely rehydrated.

W. A.

—*The Illustrated Weekly of India,*
October 24, 1943.

Crop Reporting in America

BY

S. Thotapali, M.A., B.Ed.

1. Introduction

The crop-reporting service of the United States of America is an impartial agency, operated in the United States Department of Agriculture in co-operation with 35 of the States and 300,000 voluntary crop reporters, for the collection, collation and publication of statistical data relating to acreage condition and production of crops, number and production of livestock, prices of farm products, and related information. Its primary purpose is to provide adequate, accurate and timely information concerning crops and livestock for crop and livestock producers. This information is also of value to handlers and consumers of farm products, and to those who provide products and services needed by farmers. The information supplied by the crop reporters concerning crops and livestock in their tracts or on their own farms is collated and analysed by the Crop Reporting Board at Washington as a basis for the crop reports. The crop reports are published in mimeographed form for immediate distribution (and printed subsequently). As soon as they are released summaries are distributed by mail, telegraph, telephone and radio.

2. Origin of the System

In the past dealers and speculators in farm products of the United States of America were obtaining enormous profits through the circulation of misleading reports concerning crops, and through producers' lack of market values. Farmers were resentful of this and there was considerable agitation and discussion concerning the possibility of producers having adequate information regarding crop production before their crops had gone to the market. For public benefit therefore the Government of the United States in 1839 began to collect and publish agricultural statistics. The work gradually developed until 1912,

when the Crop Reporting Board, organised in 1905, began to forcast production of important crops prior to harvest. With the organisation of the Bureau of Crop and Livestock Estimates in 1914, definite recognition was given to the value of the work of the Government of the U.S.A. regarding crop estimates particularly to farmers and stockmen.

3. Organization

The principal base for crop statistics is the information collected by the Bureau of Crop and Livestock Estimates, Washington. The field force of the Bureau consists of an agricultural statistician in each State or group of States, and in larger States, additional assistant agricultural statisticians. These men must be of high character, qualified by training and experience for their work, competent judges of crop production, and familiar with local conditions in their States. Each is required to travel over his State systematically during the crop season, personally to inspect the crop and to interview and obtain information from farmers, heads of commercial houses, mills, elevators, buying and selling associations of all kinds, transportation companies, State and local authorities, and associations of every description. In fact, each is expected to be better informed on the general farming situation and on crop and livestock production than any other man in the State. Each agricultural statistician enlists the voluntary services of from 250 to 300 selected crop correspondents designated as 'aids', who report to him every month regarding the crops grown in the State. At the close of each month he makes a detailed estimate of the crops in his State and forwards it to Washington with full explanatory notes. Many of the voluntary correspondents are selected after personal interviews to determine their qualifications. Branch Offices are also established in various States to accumulate for record, study and comparison, all data available relating to the statistics of agricultural production in the respective States.

In addition to the salaried agricultural statisticians and crop specialists, the work has the co-operation of over 300,000 voluntary crop reporters, mostly, farmers. These men are public-spirited citizens who serve without compensation, enjoying the satisfaction derived from contributing information regarding local crop conditions of practical and financial value to tbemselves and to other producers, and receiving only such crop reports and bulletins as may be available, for distribution to them. The farmers who are voluntary crop reporters contribute data regarding acreage, condition, yield, etc., for their localities and the Bureau of Agricultural Economics tabulates and summarises such data in the form of Government Crop Reports by each State and the United States at large.

4. The Crop Reporting Board

The preparation and publication of the monthly crop reports of the United States is the duty of the Crop Reporting Board, which consists of a chairman, the technical staff of the Divisions of Crop and Livestock Estimates, and two or more agricultural statisticians from the field offices of the Division. The procedure adopted by the Board in preparing crop reports may be briefly described as follows :—

The first step in the preparation of the forecast by the Crop Reporting Board is the study of the comments of the agricultural statisticians, State by State, in the light of what has happened during the previous month in each State, taking into account the weather changes, soil conditions, progress of cultivation, relative quantity of fertilisers used, presence or absence of insect pests and plant diseases, effect of these and other factors, appearance and apparent conditions of crop, and prospective yield. The second step is the forming of an estimate by each member of the Board, separately and independently, by examination of the following data : (i) individual estimate of the agricultural statistician ; (ii) weighted averages of returns from correspondents ; (iii) weighted average of special reports, if any ;

(iv) estimate of the Board for previous month ; (v) estimate of the Board for the corresponding date of previous year ; and (vi) the ten-year average estimate of the Board for the same date. The third step is the comparison of individual estimates of members, which are usually in close agreement. Where much difference exists, the available evidence is carefully reviewed and discussed until agreement is reached.

When the basic figures for a given crop in a State have been determined by the Board, necessary computations are made to ascertain the probable total production for each State and for the United States. The figures are then entered in Tables which show State and United States comparative date, usually for the previous month or year and 5-year or 10-year averages. These Tables with comments constitute the forecast, which is released at the hour and minute previously announced.

5. Determination of Acreage

The main items on which crop estimates are made by the Crop Reporting Board are : (*a*) acreage indications for each crop as season advances ; (*b*) acreage changes for each crop from season to season ; and (*c*) the yield of each crop. These items may be briefly considered here.

(*a*) *Acreage indications :* The determination of the harvested acreage of crops is one of the most difficult problems for the Crop Reporting Board. The estimate of acreage that is likely to be harvested is made periodically as the season advances. The programme covers in a general way ; (i) indicated acreage of important crops to be planted ; (ii) estimate of acreage of a few major crops at or about planting time ; (iii) early season estimate of crops to be harvested ; and (iv) estimate of acreage of crops harvested.

(i) Indicated acreage of crops to be planted: The intention to plant reports are based on schedules issued for the purpose, and are corrected in the light of the harvested acreage of the previous season. The indicated acreage may be said to be the acreage that will be planted if the growers make the usual adjustment to weather conditions and other factors affecting their final action, and if they fail, to the extent they usually do, to plant as large an acreage as they planned or hoped. The reports are made available to the public before planting actually takes place.

(ii) Estimate of acreage at planting time: For nearly all crops for which estimates of production are made, forecasts of acreage are made during the growing season. The Crop Reporting Board estimates on July 1, the acreage of each crop based upon June acreage schedules. These reports are, however, not intended to represent the total acreage planted since early planted acreage may be abandoned about July 1. Such incidental loss of acreage is allowed for in the process of estimating by the Board, in order that forecasts of production may be more nearly comparable with subsequent estimates.

(iii) & (iv) Estimates of crops harvested and to be harvested: In December of each year, acreage actually harvested is separately and independently estimated, taking into account the various changes in utilisation of many crops. Small grains are cut for hay (or sometimes pastured), hay crops are often pastured, certain crops like legumes are harvested partly for grain and partly for hay, some acreage is ploughed under for green manure or for other reasons. Revised estimates of acreage planted are not ordinarily made except for cotton and fall-sown grains. Extensive and detailed data are collected for the December estimates, since these are measures of production that stand on the record to represent trend of agricultural production.

(*b*) *Acreage changes from year to year:* The basis, or foundation of all accurate reports of crop production is not only the acreage in particular crops

reported, but also the total acreage in cultivation and an accurate determination of changes made from season to season. Several good methods, which altogether give reasonably accurate measure of annual changes in acreage, have been used by the Crop Reporting Board. The more important of these are: (i) individual farm survey method; (ii) ratio relative method; (iii) crop-meter; and (iv) other methods.

(i) Individual farm survey method: This is still a very important method and consists in getting from a large number of individual farmers, the acreage figures for their own farms for each crop in the previous year. The individual farm surveys are made twice a year—first in June by mailing out schedules to about 300,000 farms to furnish data for July 1 acreage reports; and second in September, over a half-million schedules being sent out through rural carriers —and afford the basis for December revisions. The material, when received, is grouped into four classes to avoid giving undue weight to large farms, which usually constitute a preponderance of the returns. With this data the acreage is determined, and a direct comparison of the acreage in each crop reported on the same farms for the two years is made, from which the percentage of change in each crop is determined, weighted by district or country.

(ii) Ratio-relative method: This is a method of arriving at the change in acreage for a given crop from one year to another from a comparison of the ratio which each crop bears to all crops (or to all land in farms) on sample farms. For example, if it is found that on a sample farm corn constitutes 30% of the area devoted to crops for 1938 and 33% for 1939, there is an indication of a 10% increase in the acreage in 1939 over 1938. There are two important presumptions in this method; (1) an identical total acreage for each of the two years—a very doubtful assumption; and (2) a sufficiently large sample—an insufficient sample reflecting fluctuations in sample rather than fluctuations in actual acreage!

(iii) Crop meter: With a view to avoiding the inevitable bias in the above subjective methods, a system of measurement of the frontage of crop fields along a highway, by means of a "crop meter" attached to an automobile speedometer, has been introduced. It is stated to be of inestimable value in indicating the relative change in acreage from one year to the next for cotton and some other crops. The frontage of each crop along representative routes is measured each year, enabling a direct comparison of the acreage between the current year and the previous year.

(iv) Other methods: In some States the correspondents are asked to report the number of acres of a given crop in 100 acres of various crops in the farm. By comparing the percentage from year to year in various kinds of crops it is possible to work out fairly accurately changes in the area of crops. In a number of States accessors are required to record the acreage of crops. These are said to be very useful. Some work has also been done in correlating prices and other factors with the acreage in the succeeding year. Studies of this kind are being made for various crops, and it is believed that they will afford a very valuable check on other methods. Use is also made of records of receipts at mills and elevators, and shipments of grain, and the ginning of cotton, which afford ways of checking the acreage figures of crops, and keeping the Department from getting very much out of the line.

6. Forecasts of Crop Production

The problem of forecasting the probable production of a given crop during the growing season may be divided into two phases—estimating the acreage of the crop to be harvested, as described in the previous section, and forecasting the probable yield which will briefly be described here. The forecasting of yield is

based upon the relation of the condition reports, or estimates of the condition of the crop, expressed as a percentage of a normal in the current year, interpreted on the basis of the relation of condition and final yield in past years. The crop reporters are asked to report on the condition of the growing crop in percentage of a normal or full crop.

Before describing how the forecast of yield per acre is made with the information supplied by crop reporters, the term "normal condition" may be briefly explained. Now, "normal condition" is synonymous with full "condition," giving promise of a full yield per acre. "Condition refers to the status of the crop in comparison with normal growth and vitality at a particular date. The individual crop reporter compares the present appearance (state of growth, healthfulness, freedom from disease, tilth of soil, etc.) of the crop with his mind picture or concept of how the crop should look at this time to yield a normal or full crop. He reports the former as a percentage of the latter.

The making of a forecast of yield per acre on the basis of the data available on the first of a given month during the growing season is a statistical problem in the relationship between a series of data currently available and the yield per acre series over a period of years. These series are graphically correlated with yield per acre over a period of years as a dependent variable, and the appearance of the crop at a given date, such as August 1, measured by the crop reporter's estimate of "condition of the crop as a per cent. of normal" as an independent variable. As a matter of actual procedure, however, the regression lines are seldom computed. In the place of these lines it is customary to draw in lightly a proportional line through an observation for a year in which the yield can be carefully checked. Such a year is, for example, 1929 in which a complete census enumeration was made of the acreage and production so that actual yield per acre could be computed. It is not necessary that this proportional line should pass very closely to the mean of the observations since its principal value is to orient the observer with respect to the location of the point of zero condition and zero yield when it is not convenient to show that point on the chart. (Illustration omitted.)

Estimates of crops yield per acre are also made at or after harvest, based on analysis of reported community or individual farm yields in relation to census or other known yields. The reported yields per acre by crop reporters being more or less selective, usually need adjustment to conform to the average for all farms and all communities. Consideration is also given to memory and cash crop bias in converting reported yields to actual yields. When official estimates of yield per acre are compared with yield per acre derived by dividing production reported by the census, it is stated that the two are in reasonably close agreement.

The problem of forecasting yield per acre is also being approached from an entirely different angle. Each method so far outlined required the individual crop reporter to interpret the effect of weather conditions upon yield. Attempts are being made to measure mathematically the relationship between early growing season weather conditions and final yields. The methods are complicated owing to the large number of weather factors which effect yields, but in general they are an extension of the correlation method. The United States Weather Bureau has been studying the relation of weather factors to yields. The results so far obtained are said to be sufficiently promising to justify much more extensive investigation than has been attempted heretofore.

7. Use and Value of Crop Reports

It is claimed that the crop reports and statistics published by the Government benefit all classes of people in the United States, especially producers,

marketing and distributing agencies, because they relate to the essential facts of production and supply of food and raw materials, and are unbiased, disinterested, authoritative and timely. The value of the reports is outlined as under:—

(*a*) Farmers:

Directly—

1. Guide to increasing acreage of particular crops.
2. Guide to marketing—whether to hold or sell.

Indirectly—

1. Prevents issue of biased, false and misleading reports or minimises their effect.
2. Reduces speculation.
3. Aids transportation companies to furnish proper supply of cars.
4. Better distribution of farm equipment and supplies.

(*b*) Co-operative Farmers' Associations:

Enables them to formulate constructive programmes and policies, and market their products intelligently.

(*c*) Dealers and Handlers of Agricultural Products; and

(*d*) Agricultural Extension Workers:

Aids them in preparing crop production programmes.

(*e*) States Marketing Bureaux:

Aids in developing State marketing programmes.

(*f*) Bankers and Financiers:

Enables them to provide in advance funds needed to finance crop production, storage and marketing.

(*g*) Railroads:

Enables them to estimate number of cars that must be provided to move crops.

(*h*) Insurance Companies:

Furnishes data on which to base crop insurance and to place farm loans.

(*i*) Manufacturers and Merchants:

1. Guide to determining quantities to manufacture.
2. Make best geographical distribution of product.
3. Show where to concentrate selling campaigns.

(*j*) Advertising Agencies:

Where to place advertising to the best advantage.

(*k*) Produce Exchanges:

Permits better adjustment of prices from day to day.

(*l*) Prospective Investors and Settlers:

Guide to relative agricultural resources and advantages of different parts of country.

(*m*) Economists:

In studies of business and agricultural conditions.

(*n*) Businessmen Generally:

Guide to determining whether to expand or contract.

8. Efficiency of the United States System

The International Institute of Agriculture at Rome considers that the Crop Reporting Service of the United States is more thorough and complete in its work than that of any other country. The volume of information compiled annually regarding agriculture, the accessibility of the information, the application being made of it to the great problems of the country, is really admirable. Its low cost is due to the fact that the reports are supplied by the leading citizens of each community gratuitously. It is the clearing house for the statistical information contributed by those interested in agriculture, and it is intended to benefit all who study and utilise the material available.

—*Journal of the University of Bombay* (July, 1943)
Vol. XII (New Series), Part I.

A Novel Method of Subsoil Irrigation

In the *Illustrated Weekly of India* of Sunday, the 24th October 1943, Mr. R. Dorai Rajan, describes a novel system of subsoil irrigation introduced by Brigadier J. G. Howson:—

"The method is specially suitable for sandy and loamy soils and might appeal to garden lovers in big cities like Bombay, Calcutta and Madras. Those who have worked the method claim that subsoil irrigation saves three-fourths of the labour involved in the surface watering of plants, makes the water go five times as far, increases the yield by a third on an average, reduces the surface-caking of plant beds and, what is most important, that it is possible by this method to grow plants when conditions are otherwise unfavourable due to scarcity of water in hot weather. The method is not costly as only earthenware pipes, which can be made by any country potter, are used.

Simple Method

The method is simple. Cheap, countryside earthenware pipe sections, three inches in diameter, are laid in level trenches about 12 inches or even less below the surface of the soil. The pipe sections, which have half-inch collars at one end, are laid end to end with small gaps—say half an inch—in between in order to allow water to seep into the soil. At each end of a pipe line a bend section of pipe, also of earthenware, is introduced, into which a pipe section is inserted vertically to reach the surface of the trench.

Water poured into this vertical section will travel down the whole length of the trench and begin gradually to seep into the earth. When the ground becomes thoroughly drenched, the capillary action of the soil commences and brings the water from the drain to within an inch of the soil surface.

Coming to details, the floor of the trench must be continuous straight line and the bottom level. The level can be tested by pouring some water into the trench and seeing that it flows evenly and does not stagnate in pools. The pipe line must not be looked upon as a water-tight drain pipe and nothing in the nature of a syphon should be attempted. Pipe lines may be laid from six to eight feet apart for growing of cereals ; vegetables, including tomatoes, will grow excellently on any ground in either side of a subsoil pipe within 18 inches of it.

Before pipe laying commences, each pipe section should be tapped to ensure hat it is not cracked or damaged in any way. It must also be borne in mind hat pipes must be well baked in the kiln so that they do not disintegrate in the renches after some time. Well-baked pipes will, of course, last for years.

The longest pipes that country potters can turn out are from 12 to 14 inches. The length of a pipe line may vary according to the length of the bed designed or a particular crop, but if it is more than 40 feet, it would be desirable to ntroduce earthen T sections at intervals of about 30 feet all along the line and o fit vertical pipe sections into them, so as to let water into the middle of the ipe line as well.

Even Percolation

The pipe sections should be laid in the bottom of the trenches almost end to end but it is important to see that the sections do not actually touch. The collar at one end of the pipe sections will provide for even seepage of water and will also obviate the danger of silting. It has been found that pipes without collars can also be used, leaving a space of half an inch between the pipe sections. Very little, if any, silting of the joints was noticed.

After the pipe line has been laid, the trench should be filled in with powdered or well disintegrated earth till only the upper edges of the pipe remain visible. Water should then be let in through the vertical section of the pipe and the trench examined in due course to ensure that water is flowing smoothly down the whole course of the drain and damping the earth at all the joints.

If proper care is taken when the pipe-laying is in progress, trouble can be avoided later on. After this test is over the trench should be filled to the surface with more powdered earth, rejecting big clods and stones. The soil over the pipe line can be strengthened by using fillings of charcoal dust and rotted and unrotted manure, if available.

Experience has shown that the vertical sections at each end of the pipe lines are invaluable for inspection purposes; they will show whether water is reaching the end of the pipe or not. Besides, they prevent the possibility of an air-lock and will allow of the ingress of fresh air down the full length of the line when no water is passing through it, thus facilitating aeration of the subsoil and discouraging roots from working their way into the pipes.

Lateral Spread

The lateral spread of subsoil irrigation is a varying factor and in very dry soil the spread is slow and limited in extent, three to four feet being all that can be expected. A fall of one inch of rain or more will result in a doubling of this lateral spread as the capillary action is increased at once.

Soil once damp appears to remain damp so long as water flows through the subsoil pipes once every third or fourth day. The maximum lateral spread has been found to be 24 feet in light sandy soil, even with clay below.

Brigadier Howson, who had his experiments inspected by Dr. W. Burns, Agricultural Commissioner with the Government of India, claims that a 40 per cent. return per annum on capital outlay can be expected from food crops and vegetables and that tomatoes and lucerne growing will yield a hundred per cent. return in about eight months. His experiments with grass proved that perfect grass for grazing sheep, cattle and horses could be grown all the year round.

This scheme can also be worked utilising sullage water, barrack room water, water from ablution rooms and from *dhobi* ghats—by employing the same basic principles, but slightly more elaborate methods involving certain devices for filtering the water."

1401-43.—Printed at The Bangalore Press, Bangalore City, by G. Srnivasa Rao, Superintendent.